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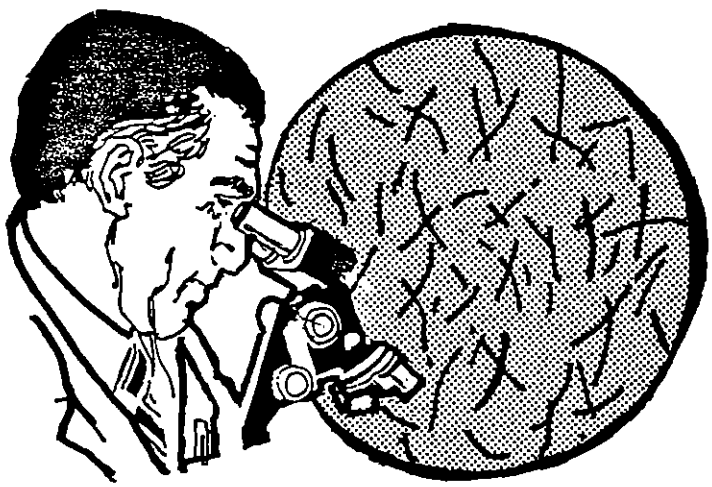
Measuring Airborne Asbestos Following An Abatement Action



MEASURING AIRBORNE ASBESTOS FOLLOWING AN ABATEMENT ACTION

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5.2 STATISTICAL CONSIDERATIONS FOR USING RELEASE CRITERIA

If samples of air are taken in the same general area but at slightly different locations or at different times at the same location, the measurements of sampled material will differ. Likewise, side-by-side samples taken at the same location and time will vary. Thus, measurements of airborne asbestos at an abatement worksite will be variable irrespective of abatement activities or post-abatement cleaning efforts. The task at hand is to understand this variability, and, using standard statistical procedures, to determine whether two measurements are truly different or differ only due to normal (expected) variability.

The variability of measurements of airborne asbestos has two components--sampling and analytic variability. Sampling variability is due to random fluctuations in the constituents of an air mass, and to systematic factors such as air circulation patterns in a room. Analytic variability is associated with the instruments and procedures used to sample air and analyze the samples.

Recent EPA research studies provide information on the magnitude of sampling and analytic variability for measurements of airborne asbestos using TEM (USEPA, 1983; Chesson et al., 1985a; 1985b). The results of the analyses of variability in these studies are expressed as the coefficient of variation (CV). The CV is simply the standard deviation of a series of measurements divided by the mean value.*

The first study (USEPA, 1983) produced estimates of sampling variability. A CV of 0.88 was found in simultaneous measurements of airborne asbestos among rooms with ACM in 25 school buildings within a single school district. Since the measurements of asbestos were adjusted for between-school variation in mean asbestos levels, the measurements can be considered reflective of spatial variability in a single area. Variability over time was estimated as the CV for average weekly levels of asbestos in three different schools (CV = 0.42). Spatial and time variability combined would thus be a CV of about 1.0.**

The other two studies (Chesson et al., 1985a; 1985b) estimated the analytic component of variability. Using the variation between laboratories in 49 pairs of TEM measurements of asbestos as the indicator, analytic variability was estimated as a CV of-about 1.0.

Based on these limited studies, expected variability in asbestos levels at a single location (e.g., an abatement work site) as measured by TEM may be characterized by a CV of between 1.0 and 1.5.

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* Since the variability of measurements of airborne asbestos tends to be larger if the average value is high, a high standard deviation may reflect a high variability and/or a high mean for the measurements. Dividing the standard deviation by the mean thus allows the variability of measurements with large means to be compared with the variability of those with small means.

** CV's are combined by taking the square root of the sum of each CV squared.

This information on the normal or expected variability of asbestos fibers is used in the following sections to calculate the required number of samples for determining compliance with the TEM release criterion. (A different approach is used for the PCM criterion.) Of course, the actual variation in asbestos levels at any site is calculated directly from the measurements at that site. The degree of expected variability is assumed solely for the purpose of determining sample design specifications before the measurements are made.

5.3 TEM RELEASE CRITERION

As noted previously, the recommended criteria for releasing the abatement contractor if TEM is used involves comparing asbestos levels at the work site with those measured outside. Only if the asbestos levels inside are not statistically larger than those outside the work site, would the contractor be released.

5.3.1 Sampling Volume and Time

The required sampling volume is determined by the lowest level of asbestos to which the work-site environment must be reduced. As shown in Table 5-1, typical ambient asbestos levels are on the order of 0.001 in rural areas and somewhat higher in urban areas. Based on these data, enough air must be sampled to detect a concentration of approximately 0.005 f/cc. As described in Chapter 4, a volume of at least 3,000 liters per sample is required if the sample preparation involves direct transfer to the EM grid, more if the indirect sample preparation technique is used. At a rate of 2-12 L/min, sampling would require from 3.5 to 21 hours.

5.3.2 The Number and Location of Samplers

The number of samples needed to reliably determine compliance with the release criterion depends on several factors. Table 5-2 lists these factors and illustrates their influence on sample size.

The first two factors are the expected errors regarding decisions on satisfactory cleaning of the abatement work site. These are the probabilities that no difference between levels inside and outside the work site will be detected when the work-site asbestos levels are actually too high (false negatives), or that a difference will be detected when the work-site levels are actually low enough (false positives).

The third factor ("inside-to-outside multiple") is related to the false positive and negative error rates. Since small differences between inside and outside asbestos levels are more difficult to detect than large differences, more samples are needed to maintain the same rates of making errors in decisions. For example, as shown in Table 5-2, if the CV for TEM is 1.5, seven samples are required to detect a 5-fold difference between inside and outside levels with a 10-percent chance of making a wrong decision. However, only four samples are required to detect a 10-fold difference. In other words, if seven